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ABSTRACT

An approach to teaching mildly retarded children math skills using finger calculation is discussed. Drills progress from using one to two hands and doing multiplication and division. The appropriateness of finger calculation with children in the sensory motor and preoperational stages of development is noted, and the approach's ability to enhance arithmetical understanding and skill development is commented upon. Findings of three studies are cited to illustrate the use of the finger math system. (CL)

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Finger Mathematics for EMR Children

Earl J. Ogletree and Maria Chavez

Many handicapped children leave school with mathematical deficiencies. They do not attain mathematical skills much beyond the fourth grade. The major problem appears to be one of methodology, i.e., finding a meaningful method of teaching that is concrete and related to the learning style of EMR children.

Manipulatives are generally used to teach and reinforce understanding of operations, concepts and abstractions. Although working with concrete objects involves motoric skills, it does not fully involve the children in the learning process. Use of manipulatives is more abstract than it is concrete when compared to the direct use of the fingers.

Fingers are a common vehicle for non-verbal communication for young children. They use them to play with toys and objects, to point to things they see or want or count. Finger counting and calculation is not only used by children in primary grades, but children who have failed to intellectualize the four basic arithmetical processes and rely on finger counting. It appears finger manipulations would be a natural method for introducing and teaching the basic processes of addition, subtraction, multiplication and division to children, particular EMR children.

Of recent a rationale finger system of calculation was developed. This system known by various names such as sensory math, fingermath and finger calculation or by its original name Chisanbop was developed by Hang Yung Pai in Korea. It was brought to the United states in 1976.

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Basically, finger calculations is a finger manipulative method of performing the four basic operations with whole numbers, executed by the ten fingers. The right hand represents the units place, the left hand the tens place, and by means of a systematic sequence of finger positions one can count to 99. For numbers above 99, the sequence is repeated.

Teaching finger calculation is not difficult; drill is an integral part of the process. A sequential procedure must be followed. First the numerical value of the fingers must be learned. Beginning with the right hand, each finger has value of <u>one</u> and the thumb has a value of <u>five</u>. Ask the children to think of pennies and nickles. <u>Pressing</u> is accomplished by placing (pressing) fingers on a surface. Clearing refers to releasing fingers from the surface. (see figure 1)

The children should begin with the right hand pressing 1, 2, 3, 4, 5, 6, 7, 8, 9 in sequence, then randomly drilled until mastery is attained. The lesson should be about fifteen minutes. The teacher should proceed slowly and carefully so as not to introduce new skills until preceding skills have been mastered. It is important that the children not be frustrated.

Teaching of addition to sums of ten using only the right hand should be introduced next. For the immature or slow learner only pressing to four or six should be practiced first. For older and faster learners the left hand could be introduced.

When introducing addition, begin with simple sum to four; for example:

Press two. How many more?

$$\begin{array}{cccc} 2 & 3 & 2 & 1 \\ \underline{+0} & \underline{+1} & \underline{+2} & \underline{+2} \end{array}$$

Read your fingers.

Then use the same sums in a horizontal form such as: 1 + 1 + 0 =

2 + 1 + 1 + 1 = 3 + 1 = . Provide enough practice for the child in order that he may master this beginning step in addition. Practice and reinforcement are the key to learning this form of mathematics. Such problems as:

$$\begin{array}{cccc} & & 1 & 2 \\ 3 & 4 & 1 & 2 \\ \underline{+2} & \underline{+1} & \underline{+3} & \underline{+1} \end{array}$$

and the horizontal version of the sums of five - 3 + 2 = , 1 + 2 + 1 + 1 =

2 + 3 = 2 + 2 + 1 = must be mastered before the learner proceeds to higher sum. Then the learner may proceed to sums of six, seven, eight and nine. Each must be mastered before proceeding to the next sum, and of course the problems are presented a variety of fashion vertically, horizontally; then orally with nothing written, written only and combinations thereof.

Since finger calculations is based on the decimal system, the left hand

represents values of ten. Each finger is ten, the thumb is fifty (think dimes and fifty cent pieces.) Have the children press 20, 40, 60, 90, 10, etc. (see figure 2.)

The following step is to use both hands. Students would press 52 (press thumb left hand and press two fingers right hand). Here the students beccme aware of the numerical values of each hand. Ultimately they should be able to count and add numbers up to 99. The numbers that will require additional drill are those that contain the digits of 6, 7 or 8 in the ones or tens place.

In the addition of numbers with sums above 4, the 4-5 exchange needs to be taught. For example 2 + 3 involves the pressing of two fingers plus three fingers. Count "one, two," flip to thumb, three (4-5 exchange). Read fingers (thumb) -- "five."

The sum of ten is another crucial point because it involves the 9-10 exchange. The learner presses nine and adds one more by lifting the right hand and pressing the index finger of the left hand in a simultaneous motion. For example 7 + 5 involves the pressing of seven and five more. Press right thumb and two fingers. Then press ring and little finger (the entire right hand is pressed), Jump to index finger to left hand (10) and make 9-10 exchange. Holding left index down, press index and middle fingers on right hand. Read fingers--"twelve."

If the student masters the 4-5 exchange and 9-10 exchange he will be capable of performing the beginning stages of addition, subtraction, multiplication and division. Consequently sufficient practice for sums of ten is very important. Example Problems:

					6
3	4	5	8	9	2
+7	+6	+5	+2	+1	+2

2 + 1 + 7 = 3 + 2 + 3 + 2 = 4 + 6 = 1 + 9 = 6 + 2 + 2 =

Clapping may also be used to strengthen the auditory perception of learners.

Instead of saying the number the teacher would clap, tap, stamp or click, the amount.

Finger manipulation for subtraction is the reverse of addition. To perform 4-3, simply press four and then release 3 fingers from right to left, while counting one, two, three. Read fingers -- "one."

Multiplication is repeated addition. The child begins with the two table by first pressing two, then two more and two more, etc. For example 2 x 4 = would involve pressing two four times. Then read fingers, "eight." Although the process may appear difficult, it is not. Children develop a rhythm and speed which becomes automatic by simple practice. The five and nine tables are the most fun in that it requires a simple exchange of fingers of the right and left hands. For example in the nine table the child presses nine (thumb and four fingers of right hand). To add nine more press a ten (index finger of left hand) and release little finger of right hand, equals 18.

Division is a little more difficult, but not impossible. Division may be done by using multiplication by simply rewording the question. Example: 2 x 9 is equal to one nine, two nines equals eighteen. Then eighteen divided by nine equals is equal to how many nines in eighteen. Press one nine, two nines. Stop the fingers read 18. How many nines did you press? "Two nines". Once the child masters multiplication he has also mastered beginning division.

The authors have seen five year olds using the finger calculations competently, swiftly and joyfully. One of the authors (Maria Chavez) successfully taught her four and six year old girls finger calculation, even though the younger child had little or no number concept, i.e., she did not know how much 10 was. Maria Chavez has taught the finger calculation system to non-handi-

capped and handicapped children and teachers and administrators.

Finger calculation is a natural vehicle to learn mathematics for young children because it involves psychomotor activity, sense of touch and visual stimulation, it provides a natural bridge between sensory input and intellectual interpretation. Children best learn mathematical concepts and skills by first experiencing numbers physically, then visually, then emotionally and lastly conceptually. In summary:

Steps in Learning	Finger Calculation
1. Associating number experiences to physical movement.	1. Pressing of fingers
2. Associating number experiences to seeing.	2. Visual consciousness (watching fingers).
3. Associating number experiences to feeling and hearing.	3. Individual oral and choral recitation.
4. Associating number experiences to thinking.	4. Intellectual interpretation.

Using the finger calculation method to learn arithmetic is supported by Piaget's stages of cognition. The first stage ages 0-2 years is the sensory motor stage in which learning is mainly a psychomotor activity. At the preoperational state (2-7 years of age), thinking is sensory bound. Children are involved in direct perceptual relationships with a minimum of reasoning. For the most part, they are unable to distinguish between how things look and how they really are. They cannot hold mental images without concrete stimulation or reinforcement. At the concrete operational state (ages 7-14 years), thinking is more operational, pictorial, free from the senses, but needs concrete support for problem solving.

Analysis of these sequential stages indicates that children gain greater

voluntary control over the thinking process as it is gradually released from the physical body and dependency on the senses. Therefore, learning is hardly ever a purely cognitive process for children. It includes physical and emotional involvement--interest, motivation and preference. Therefore, for effective and efficient learning to take place, the methods of teaching and learning must be compatible with the learning style of the children.

Finger calculations appears to meet these criteria because of its psychomotor base. Steiner (1964) agreed with this approach:

> The less we train the intellect directly and the more we aim at treating (teaching) the whole child in such a way that out of motoric activity, out of the dexterity the intellect will evolve. Learning to think directly through the head is not the kind of (learning that will last for young children). He will become tired and disinterested. But if he has to do actions with his own body which need to be thought out first, this will develop thinking in the proper way. (Learning will be facilitated and retention increased p. 25).

This has some logic. Learning and eventually becoming proficient in a skill is in the forgetting of the process. We acquire the ability to write because we have forgotten the process which has sunken into the subconscious. Perfection is in the forgetting of the learning process. As a result of using finger calculations to facilitate the learning of the four mathematic operations, mathematical skills emerge as an ability because the physical/oral/cognitive experience has sunken into the subconscious. Learning finger calculations is similar to learning a musical instrument or learning a sport--skating or skiing--in that the basic skills of finger calculation must be learned thoroughly before moving on to more complex manipulation skills. Although finger calculation

is relatively simple, the tempo of the teaching process must be slow to maintain confidence and motivation. Speed is not encouraged, but practice is.

Finger calculation is not a panacea or replacement for the regular mathematic curriculm or classwork. It is an introductory reinforcement and supplemental technique. Oral recitation is used to accompany the pressing of numbers with the fingers as an integral facet of finger calculations. Oral exercises and choral counting help to focus the children's thinking and reinforce finger manipulations. It gives the teacher, the opportunity to evaluate their progress and to correct inappropriate calculation patterns. The multimodes of learning (visual, auditory, oral, touch and psychomotor) using finger calculations provide a natural and compatible media for children of all abilities, including the handicapped. For children with laterality difficulties or poor motor-visual skills or auditory coordination, finger calculations not only facilitates the learning of mathematical skills, it can help to ameliorate their handicapping conditions.

Finger calculations has become increasingly popular and effective in the United States with all kinds of children, young to older, handicapped to non-handicapped. It has been shown that young children who have learned the finger calculation system can add, multiply, subtract or divide numbers faster than an adult using an electronic calculator. The issue is not the speed in finding answers to problems, but the feasibility and applicability of using finger calculations to enhance arithmetical understanding and skill development.

Several research studies have shown the finger calculation method to be successful in increasing academic achievement. A study project conducted by the Texas Education Agency (1978) included eleven first and second grade, ten third grade and fourteen remedial fifth grade classes selected on a random

basis. An equivalent control group was used. Both groups were given a pretest and a post test after sixty days of instruction. An analysis of covariance showed a statistically significant difference favoring experimental groups at each grade level.

Chavez (1980) compared the arithmetic achievement of twenty-nine Chicago, black inner-city second grade students taught by the finger calculation method with twenty-seven control group students taught by traditional math instruction. After five months of instruction, the finger calculation group scored significantly higher (.05) on the IOWA test in arithmetic than the control group.

Gurau and Lieberthal (1979) found their finger math system to be successful with all children:

> A year of involvement...of both normal and obviously handicapped children has demonstrated... that exposure to finger math techniques is helpful as well as enjoyable for the children (p. viii).

The procedures for teaching finger calculations to handicapped children does not appreciable differ from those for non-handicapped children except to proceed at a slower rate with more reinforcement. An advantage of finger calculations is that it lends itself to easy diagnosis, and individual one-to-one instruction by other students or a sibling or a parent at home. Because of its multi-sensory, multi-active approach, it provides many avenues for all children to learn. Activity for children is synonymous with play; play begets motivation, and motivation begets learning. Finger calculations (finger play) is a method "whose time has come" for implementation in the special education curriculum.

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